The early functional outcome of Mau osteotomy for the correction of moderate-severe hallux valgus

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Abstract

Hallux valgus is one of the commonest conditions of the foot and has been reported to affect nearly half of the adult population. It is most effectively treated by a corrective osteotomy of which there a numerous subtypes. The Mau osteotomy confers the greatest structural stability but is not thought to provide adequate correction of moderate-severe deformities. Accordingly, complications such as under correction and non-union are common. The aim of this study was to determine the functional outcome in patients with moderate-severe hallux valgus following a Mau osteotomy. A retrospective review of 23 patients with moderate-severe hallux valgus treated by Mau osteotomy was conducted. Patients were assessed clinically by the American Orthopedic Foot and Ankle Society (AOFAS) scoring system and radiologically by measuring the first intermetatarsal (IM) and hallux abductovalgus angles (HAV). The mean AOFAS score had improved from 47 preoperatively to 92 postoperatively (P<0.01). Additionally, preoperative HAV and IM angles improved from 39° and 15° respectively to 15° and 9° respectively (P<0.01). There were no cases of undercorrection or non-union. In this series, the Mau osteotomy was able to achieve good correction of the IM and HAV angles in patients with moderate-severe hallux valgus. This was reflected in a significantly higher postoperative AOFAS score. Contrary to other studies there were no cases of undercorrection and despite allowing patients to fully weight-bear postoperatively there were no cases of non-union.

Introduction

Hallux valgus is a common forefoot disorder which affects 48% of adults.[1] The deformity is characterized by both valgus deviation and rotation of the hallux at the level of the metatarsophalangeal joint (MTPJ). Whilst conservative measures can provide some symptomatic relief the most effective treatment remains surgical correction. Numerous operative strategies have been employed to achieve this with the decision to choose one particular procedure typically based upon the surgeons' preference and the severity of the deformity. To assess the latter the first intermetatarsal (IM) angle can be measured. In moderate-severe cases this is greater than 15° and a proximal first metatarsal osteotomy is often required. Several such procedures have been described with good results. These include the proximal chevron, closing and opening base wedge osteotomies and the Ludloff. These though have been associated with delayed bone healing, fixation failure and transfer metatarsalgia due to either dorsal malunion or shortening.[2,3]

Mau described a through and-through, transverse plane osteotomy that extends plantar-proximal to dorsal-distal when viewed in the sagittal plane.[2] The defining feature of this procedure is the creation of a dorsal shelf which helps resist weight-bearing forces.[4,5] There have been suggestions though that the Mau osteotomy should be confined to those cases which exhibit a mild deformity because its corrective ability may be limited due to its location and morphology. Moreover, it has also been criticized for resulting in an axis of motion that is too distal and incapable of correcting the angular deformity.[2]

The aim of this retrospective study was to evaluate the functional outcome of patients who underwent a Mau osteotomy for the correction of moderate-severe hallux valgus using the American Orthopedic Foot and Ankle Society (AOFAS) scoring system.

Materials and Methods

The results of 23 consecutive patients with complete medical records who underwent a Mau osteotomy in a district general hospital between December 2007 and 2011 were reviewed. All procedures were performed by the senior author (AT). All patients with painful moderate-severe hallux valgus (IM angle >13°) which was unresponsive to conservative treatment consisting of tailor made foot orthoses were included in the study. Both pre- and postoperative first IM angles were measured by one author (UA). This parameter was defined as an angle subtended by the lines bisecting the longitudinal axis of the first and second metatarsals. The hallux abductovalgus angle (HAV) was also assessed by measuring the angle subtended by the line bisecting the first metatarsal and proximal phalanx of the hallux. All patients were assessed both pre- and postoperatively by the same author (SM) using the AOFAS scoring system.

Operative technique

The patient was placed supine and a tourniquet was used throughout. Using a standard medial approach a longitudinal ellipse of capsule was excised. Through the same incision the transmetatarsal ligament, adductor hallucis and lateral capsule of the first MTPJ were released. Following this, a long oblique osteotomy was made from plantar-proximal to dorsal-distal over the full length of the metatarsal shaft. The plantar fragment was then rotated to correct the initial deformity and restore normal anatomical alignment. This was secured with fracture reduction forceps and then two cannulated 3.5 mm bolt screws were used to stabilize the bony fragments. Capsulorrhaphy followed by skin closure was then performed. Figure 1 illustrates the pre- and postoperative radiographs of a 54 year old female who underwent a Mau osteotomy for hallux valgus. Preoperative HAV and IM angles improved from 35° and 15° respectively to 5° and 8° respectively. The AOFAS score also improved from 45 to 91.

All patients underwent the same postoperative protocol. Immediately following surgery patients were only allowed to heel weight bear using a tailor made orthosis. Two weeks later a hallux valgus splint was applied for four weeks following which radiographs were performed to assess bony union. If these were deemed satisfactory full weight bearing was permitted.

Statistical analysis

Pre- and postoperative radiographic variables and AOFAS scores were compared using the Wilcoxon matched-pairs signed-ranks test. A statistically significant difference was con-

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sidered when the P value was less than or equal to 0.05.

Results

The cohort consisted of four males and 19 females with a mean age of 52 (range 23-78) years. Of the 23 patients included for study, five had a concomitant Akin osteotomy and thus 28 procedures were performed in all. The operative side included 10 left feet and 13 right feet. No cases were performed bilaterally. All patients were assessed using the AOFAS scoring system both pre- and postoperatively and were followed-up for 12 months at which point they were all found to have healed both clinically and radiologically. As per institutional policy they were discharged at this point.

Radiographic analysis

Preoperatively, the mean HAV and IM angles were 39° (range 22-58) and 15° (range 13-21) respectively. Postoperatively the mean HAV and IM angles were corrected to 15° (range -2-36) and 9° (range 0-14) respectively. Postoperative correction of these radiological parameters was statistically significant with P 0.01.

American Orthopedic Foot and Ankle Society score

Preoperatively, the mean AOFAS score was 47 (range 34-62) and postoperatively it was 93 (range 69-100). The difference between pre- and postoperative scores was statistically significant with P 0.01. A summary of the pre- and postoperative radiographic scores and functional outcomes with corresponding P values can be found in Table 1.

Complications

There were five complications in total. One patient had metatarsalgia, one patient had chronic regional pain syndrome and three patients had superficial surgical site infections. Concerning the latter, all patients responded well with one course of oral antibiotics and no further treatment. The patient with metatarsalgia was treated with non-steroidal anti-inflammatory medicines and tailor-made orthoses which provided significant pain relief. The mean pre- and postoperative AOFAS scores for these patients were 48 (range 44-52) and 96 (range 93-100) respectively. Table 2 summarizes all the complications with their respective pre- and postoperative AOFAS scores.

Akin osteotomy subgroup

Due to a concomitant hallux valgus interphalangeus deformity it was decided intraoperatively to perform an Akin osteotomy on five patients. This cohort had a mean age of 55 years (range 29-71). Preoperatively, the mean HAV and IM angles were 48° (range 32-58) and 15° (range 13-21) respectively. Postoperatively the mean HAV and IM angles were corrected to 13° (range 5-21) and 9° (range 6-12) respectively. Preoperatively, the mean AOFAS score was 45 (range 34-52) and postoperatively it was 91 (range 69-100). Three patients had complications, which comprised of two superficial infections and one case of metatarsalgia. These were all treated satisfactorily with conservative management.

Discussion

Several kinds of first metatarsal proximal osteotomy have been described for the treatment of hallux valgus, but it is the Mau osteotomy that is thought to provide the greatest intrinsic stability.[5-7] This is primarily due to the angle of the osteotomy permitting good bony apposition which is essential for fixation. Consequently, the Mau osteotomy is recognized to be biomechanically superior with regards to its fatigue strength.[5-7] Given that it also entails one single bony cut it is relatively straight forward for the surgeon to maintain control of the osteotomy fragments. In contrast, other proximal osteotomies mandate concomitant repair of the metatarsus primus varus which is comparatively a more technically demanding procedure carrying a higher complication rate.[2]

The main concern over the Mau osteotomy is its ability to correct moderate-severe hallux valgus deformities due to the location and morphology of the bony cut. In some studies it has been shown to provide the least amount of correction when compared to other proximal osteotomies and has therefore been confined to mild deformities only. Accordingly, there is a paucity of literature assessing the results and functional outcome in moderate-severe cases. Glover *et al.*[2] reviewed 24 cases of moderate-severe hallux valgus deformities corrected with the Mau osteotomy. The mean correction of IM and HAV angles was 10° and 13° respectively. In this series 38% of cases had dorsal cortical non-union, 13% had a recurrence of the deformity and 21% were under-corrected. Bar-David *et al.*[4] followed-up 22 patients who had a Mau osteotomy in conjunction with a fibular sesamoidectomy. IM and HAV angles were corrected by a mean of 11° and 24° respectively. Complications included two patients that sustained stress fractures of the dorsal and plantar shelves and two patients that were over-corrected. Neese *et al.*[1] reported 28 patients who had a modified-Mau osteotomy combined with a Reverdin osteotomy to correct a hallux valgus deformity. The median reduction in IM and HAV angles was 12° and 21° respectively and the median AOFAS score was 95. One patient sustained a stress fracture and one case was over-corrected.

We have reported a single surgeon's consecutive series of Mau osteotomies performed for moderate-severe hallux valgus. An improvement in both the HAV and IM angles was noted in 21 patients (91%). There was a mean correction of 36° and 6° for both HAV and IM angles respectively. The difference between pre- and postoperative measurements with regards to the aforementioned parameters was

Table 1. Mean pre- and postoperative radiographic scores and functional outcomes with corresponding P values.

	Preoperative value	Postoperative value	P value
Hallux abductovalgus angle	39°	15°	<0.01
First intermetatarsal angle	15°	9°	<0.01
AOFAS Score (/100)	47	92	<0.01

AOFAS, American Orthopedic Foot and Ankle Society.

Table 2. Postoperative complications with corresponding pre- and postoperative American Orthopedic Foot and Ankle Society scores (AOFAS).

Case	Complication	Preoperative score (/100)	Postoperative score (/100)	Outcome
1	Metatarsalgia	34	69	Healed
2	Chronic regional pain syndrome	34	75	Healed
3	Superficial infection	47	100	Healed
4	Superficial infection	52	95	Healed
5	Superficial infection	44	93	Healed

also statistically significant (P<0.01). All patients were evaluated using the AOFAS functional outcome score. In all patients the score had improved following surgery and the mean improvement was 46. The difference between pre- and postoperative scores was also statistically significant (P<0.01). Complications were noted in five patients. The majority were due to surgical site infections and were successfully treated with oral antibiotics. Unlike previous reports no cases of non-union, fracture or under/overcorrection were noted. The authors' would also like to emphasize the following key steps when performing the Mau osteotomy as they are pivotal in achieving adequate correction and a good outcome: i) when the capsulotomy of the 1st MTPJ is made great care should be taken to avoid the dorsal synovial fold; ii) the osteotomy should be performed from medial to lateral and be made parallel to the weight-bearing surface. It should begin dorsal and distally and directed plantar and proximally; iii) once the osteotomy is completed the proximal part is drilled with the drill bit left inside the bone. This ensures that the rotation is more controlled.

Figure 1. Mau osteotomy pre- and postoperative anteroposterior (AP) and lateral weight-bearing radiographs. A) Preoperative AP radiograph; B) AP radiograph 6 months following surgery; C) lateral radiograph 6 months following surgery.

Conclusions

The Mau osteotomy has been shown to be biomechanically superior to other similar procedures. Its structural stability also allows patients to fully weight-bear following surgery without affecting the rate of union. Given that it is also less technically demanding and can satisfactorily correct the deformity of hallux valgus it is a favorable procedure for any foot and ankle surgeon to have in his/her armamentarium. Our experience also suggests that the Mau osteotomy also confers a relatively low rate of serious complications and that the vast majority of patients have an objectively higher functional outcome score than they had preoperatively.

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